

NEWS, AUDIO, COMMUNICATIONS AND COMPUTERS

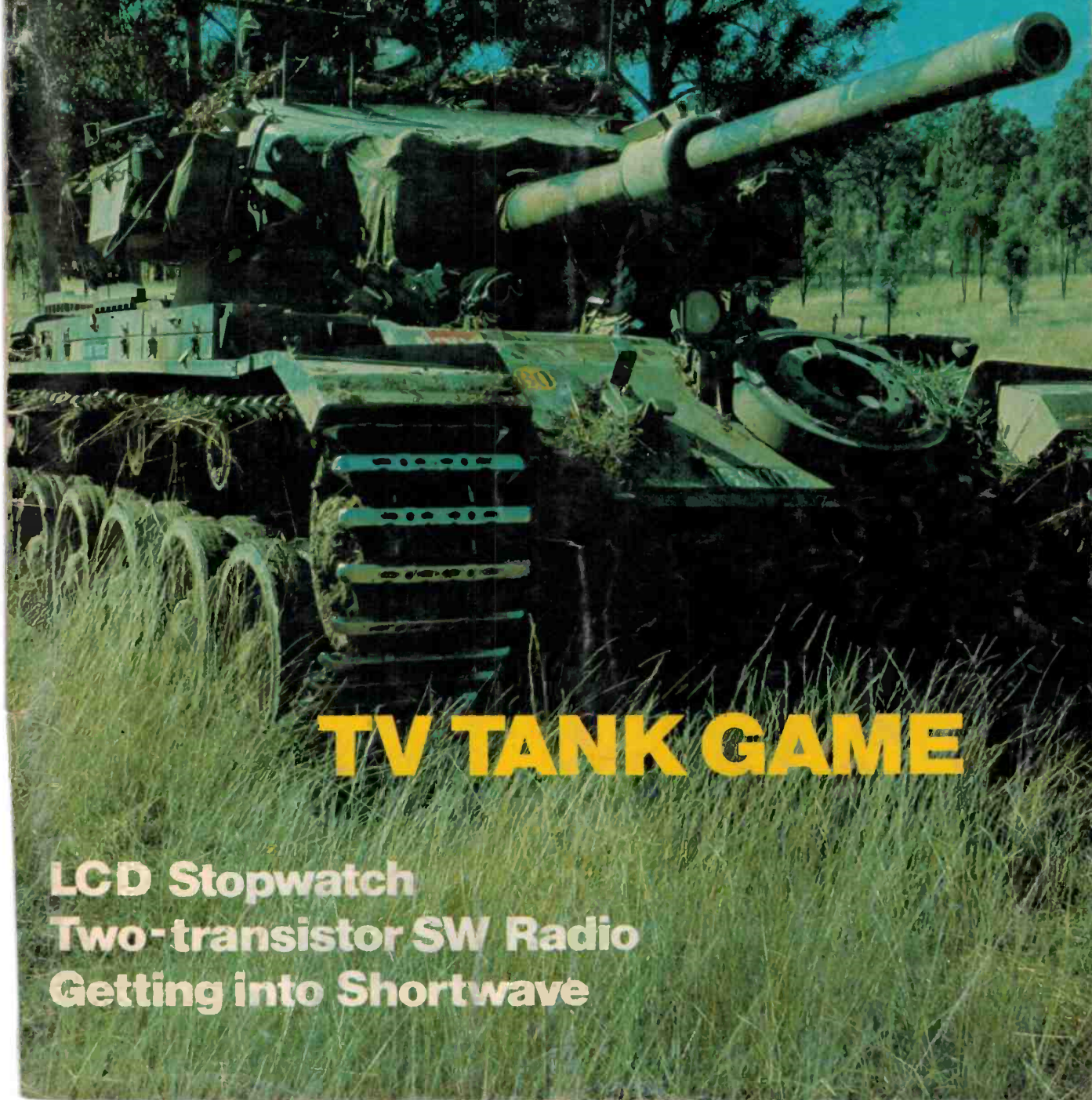
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TV TANK GAME

LCD Stopwatch

Two-transistor SW Radio

Getting into Shortwave

TV TANK GAME

'Fun for all the family', is the phrase that comes to mind — but you can have even more fun by building it yourself!

MANY DIFFERENT types of TV games have appeared over the past few years, however few continue to hold the player's interest as long as this one. The 'TV Tank Game' has been designed for two players, each of whom has a completely steerable tank with forward and reverse speed control, clockwise and anticlockwise rotation and a firing button. The tanks are also provided with delays on the movement and firing as well as variable speed to add realism. Anti-tank barricades and mines have been placed in the battlefield to retard the progress of each tank across the screen. The score is kept for each tank above the battlefield and the object of the game is to score as many direct hits on the enemy as possible. The first player to score 16 hits wins the game.

The heart of the game is the AY-3-8710 integrated circuit which is designed to operate from a battery supply with a minimum of components. All the game functions are provided by this IC.

Tank Control

When the forward or reverse button is pressed, the tank will move in the selected direction at low speed. If the button is held down, medium speed will be selected after half a second, and high speed half a second after that. Releasing the button at any speed will cause the tank to continue at that speed. To stop the tank the button for the opposite direction is pressed momentarily.

Rotation either clockwise or anticlockwise is possible when the tanks are moving or stationary.

Firing

Shells can be fired approximately once every four seconds and refire requires release and re-operation of the button. Attempting to fire during the four second delay time will give the firing sound effect, but a shell will not actually be fired.



Rotating the tank while the shell is in flight will cause the shell to follow a curved trajectory in the direction of rotation — even around barriers. The range of the shell is approximately two thirds of the screen depth or width, depending on the firing angle. Gunfire sounds accompany the firing and shell burst sounds are produced when a shell reaches the end of its range or hits a barrier, border or the enemy tank.

Barriers

Barriers can be of two different types. There are 22 fixed terrain barriers on the battlefield and provide protection from shells. Tanks cannot pass through these barriers when the interaction is selected. Six mines are distributed on the battlefield which, when hit, cause a tank to explode and become stationary with its gun inactive for a period of 2 to 4 seconds. The mine then vanishes for the remainder of the game. A mine being hit scores for the enemy tank.

Explosions

Explosion patterns are produced when a

shell is at the end of its range or when the shell makes contact with a barrier. A tank will explode and fragment momentarily when it hits a mine or is hit by a shell. Suitable explosion sounds are produced when a tank hits a mine or is struck by a shell.

Engine Sounds

Four engine sounds are produced, one for each of the speeds and one for the stationary position.

Scoring

Separate scores, one white and one black, are placed above the battlefield for each player. A player's score is incremented when his tank scores a hit on his opponent or his opponent's tank hits a mine. The game ends when one player scores 16, at which time the score flashes.

Reset

The game is reset and the scores are set to zero when the reset button is pushed. The mines are replaced and the tanks are reset to their starting positions.

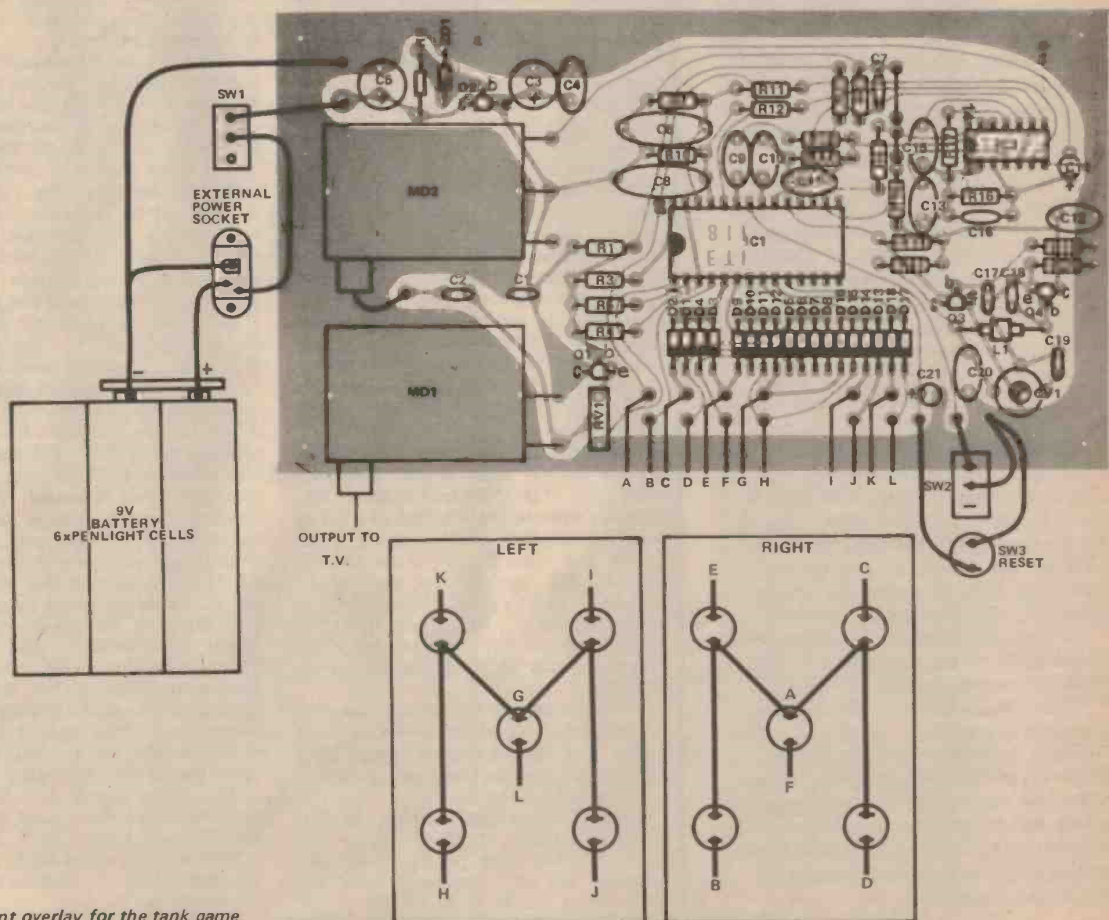
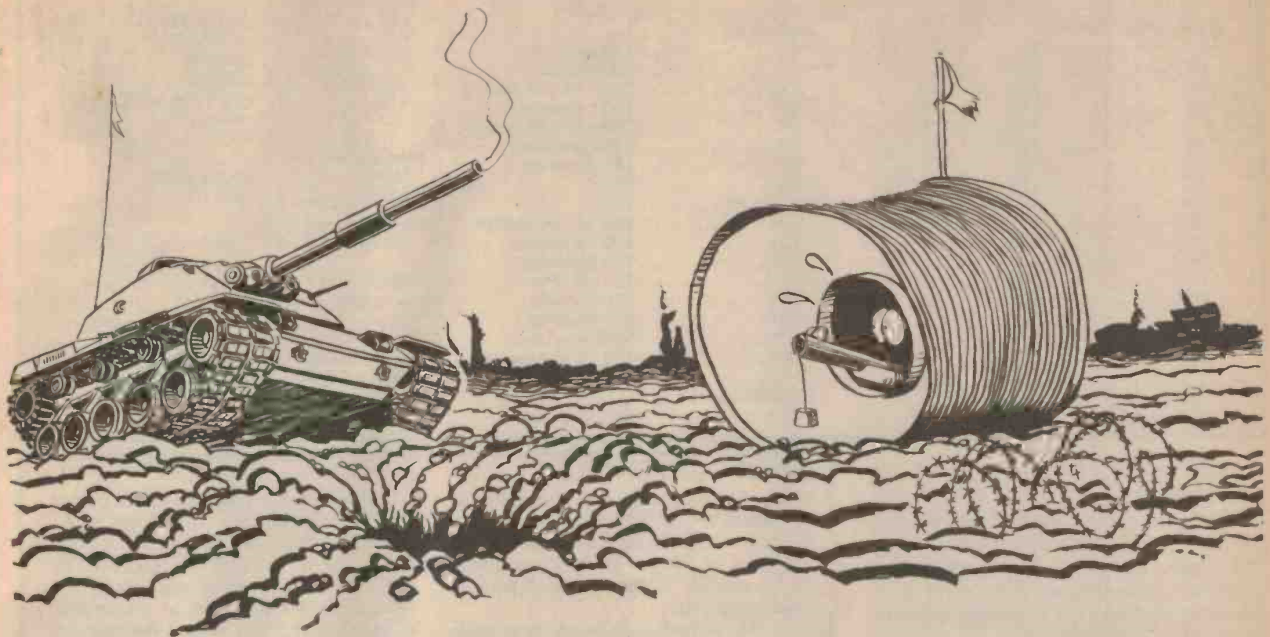


Fig. 1. Component overlay for the tank game.

PARTS LIST - ETI 811

Resistors all ½ W 5%

R1	1k
R2	270R
R3	10k
R4	1k5
R5	2k2
R6	100R
R7	1M
R8	10k
R9	18k
R10	1M
R11,12	4M7
R13	10k
R14	4M7
R15	47R
R16	10k
R17	22k
R18	4k7
R19	100k
R20	470R
R21	100k

Potentiometer

RV1 1k lin mini trimpot

Capacitors

C1	1n0 ceramic
C2	100p ceramic
C3	100µ 16 VW electro
C4	100n greencap
C5	100µ 16 VW electro
C6	270n greencap
C7	10n greencap
C8	270n
C9 - C13	100n
C14	25µ 16 VW electro
C15	100n greencap
C16	47n greencap
C17	10n ceramic
C18	33p ceramic
C19	47p ceramic
C20	100n greencap
C21	4µ7 16 VW electro

Variable Capacitor

CV1 60p trimmer

Semiconductors

IC1	AY-3-8710
IC2	4001BCN
Q1 - Q4	BC549
D1 - D18	1N914
ZD1	7V5 400 mW zener diode

Modulators

MD1	1082 AUS
MD2	UM1263

Miscellaneous

SW1,2	SPDT miniature toggle switches
SW3 - SW13	SPST push buttons pc board
ETI 811	28 pin IC socket, six way AA size battery holder, battery clip, length of 75 ohm coax, Belling Lee-type plug, RCA plug, external battery socket, length ribbon cable, plastic box 195 x 113 x 60 mm, two plastic boxes 80 x 53 x 29 mm.

Construction

The printed circuit board is housed in a plastic box with a metal top panel for the reset, power and interaction switches. Ribbon cable is used for the connections from the two small control boxes to the main unit.

Firstly, mount the components onto the pc board with the help of the overlay in fig. 1. Note that the overlay is viewed from the component, or fibreglass, side of the board. The capacitors C3, C4, C14 and C21 are electrolytics and must be inserted in the correct polarity. The transistors, diodes and the two ICs must also be correctly positioned.

It is recommended, though not essential, that sockets be used for the two ICs. If a 28 pin socket is not available for the main IC, Molex or Soldercon connectors can be used instead. Cut the connector strip into two lengths of 14 pins and solder them into the board. By carefully flexing the connecting strip back and forth, it can be removed, leaving only the pins. The IC can now be carefully inserted.

The two modulators are also mounted on the pcb and a short length of wire is used to connect the output of MD2 to the pcb track. To attach this, remove the cover of MD2 and pass the wire through the centre of the output connector and solder it to the connector's internal solder terminal.

To simplify assembly, all the external connections to the pcb are to pc pins soldered into the board.

Once assembled, the pcb can be mounted into the box. A 15 mm hole is drilled in the back and the output socket of MD1 mounted through it (see photo). Holes are also drilled for the external power socket, and the ribbon cable to the control boxes. Four small holes are drilled in the base and the pc board mounted on spacers.

HOW IT WORKS - ETI 811

Most of the operations in this game are performed by the main IC. Since it would be much too complex to describe the operation of this IC, we shall concentrate on the external circuitry required for it to operate correctly.

A TV picture is made up by a single beam of electrons hitting a phosphorescent screen which is scanned in horizontal lines, with each successive line just under the previous one. By varying the intensity of the beam the brightness of the screen can be varied. With the Australian system each horizontal line takes 64µs (i.e. 0.000064s) and every 312½ lines the beam reverts back to the top of the screen; the second "frame" fits between the first set of lines making up the total picture of 625 lines. So that the TV knows when to start the scan and to start each line, a series of pulses must be provided together with the picture information.

A pulse is needed every 20ms to give this synchronisation. These pulses are negative-going and the line sync is 4µs long while the frame sync is 250µs long. The IC gives the combined sync on pin 18. To simplify the design only 312 lines are used per frame, however this is accepted by the TV set.

All the internal timing pulses for the IC are derived from a high frequency oscillator, (4.09 MHz). Transistor Q4, together with the tuned circuit L1 - CV1, forms a Colpitts oscillator giving a distorted sine wave output at its emitter. Because this waveform is not square enough to feed to the IC, it is fed to Q3, a class C amplifier. The output from this amplifier is still not square but has a fast rise time which the IC requires for correct operation.

The movement of the tanks is controlled by the switches SW4 to SW13 which feed strobed control signals from pin 4, (tank 1 strobe), and pin 24 (tank 2 strobe), via D1-18 to the IC.

Video information appears at five different outputs of the IC. These are: pin 2 - background, pin 3 - composite blanking, pin 18 - composite sync, pin 27 - right player tank, pin 28 - left

player tank.

Because each output contains a part of the total information they have to be added together. This is done by a video mixer (R2 to R5) and the output of this mixer is fed to a buffer stage (Q1). The voltage of the waveform at the emitter of Q1 is 0.6V lower than at the base but has a lower impedance suitable to drive the modulator, (MD1). The TAB pot (RV1) controls the signal level to the modulator and is used to set the background grey level.

The video modulator contains its own oscillator running at the frequency of the TV channel used for the display. The video information is superimposed onto this carrier and fed to the TV set via the output socket and the 75 ohm cable.

So far we have only explained the operation of the video and timing circuits. Outputs are also provided for sound effects of tank engines, shell firing and explosions. These outputs appear at: pin 20 - explosion and gun fire, pin 21 - tank 1 motor sound, pin 23 - tank 2 motor sound, pin 25 - gunfire envelope and pin 26 - explosion envelope.

The output of gunfire and explosions continually appears at pins 25 and 26 and is fed to two sections of a NOR gate package, IC2/2 and IC2/3. Pin 20 is then held down to 0V each time a firing or explosion sound is wanted, which causes a pulse of sound envelope to appear at the output of the NOR gate. The motor sounds from each tank from pin 23 and pin 21 are added together, fed to IC2/4 and the resultant sound from this NOR gate added to the firing and explosion sounds. The sound is then shaped by IC2/1, the pitch being varied by the selection of R16 and C16. Audio is then coupled to the sound modulator (MD2), which is a 5.5 MHz modulated oscillator which provides the 5.5 MHz sound sub-carrier for the video modulator, (MD1).

The power supply is a conventional series regulator using a zener diode (ZD1) and a series transistor (Q2). The voltage at the emitter of Q2 is about 0.6V below the zener voltage. Resistor R6 supplies the bias current for the zener.

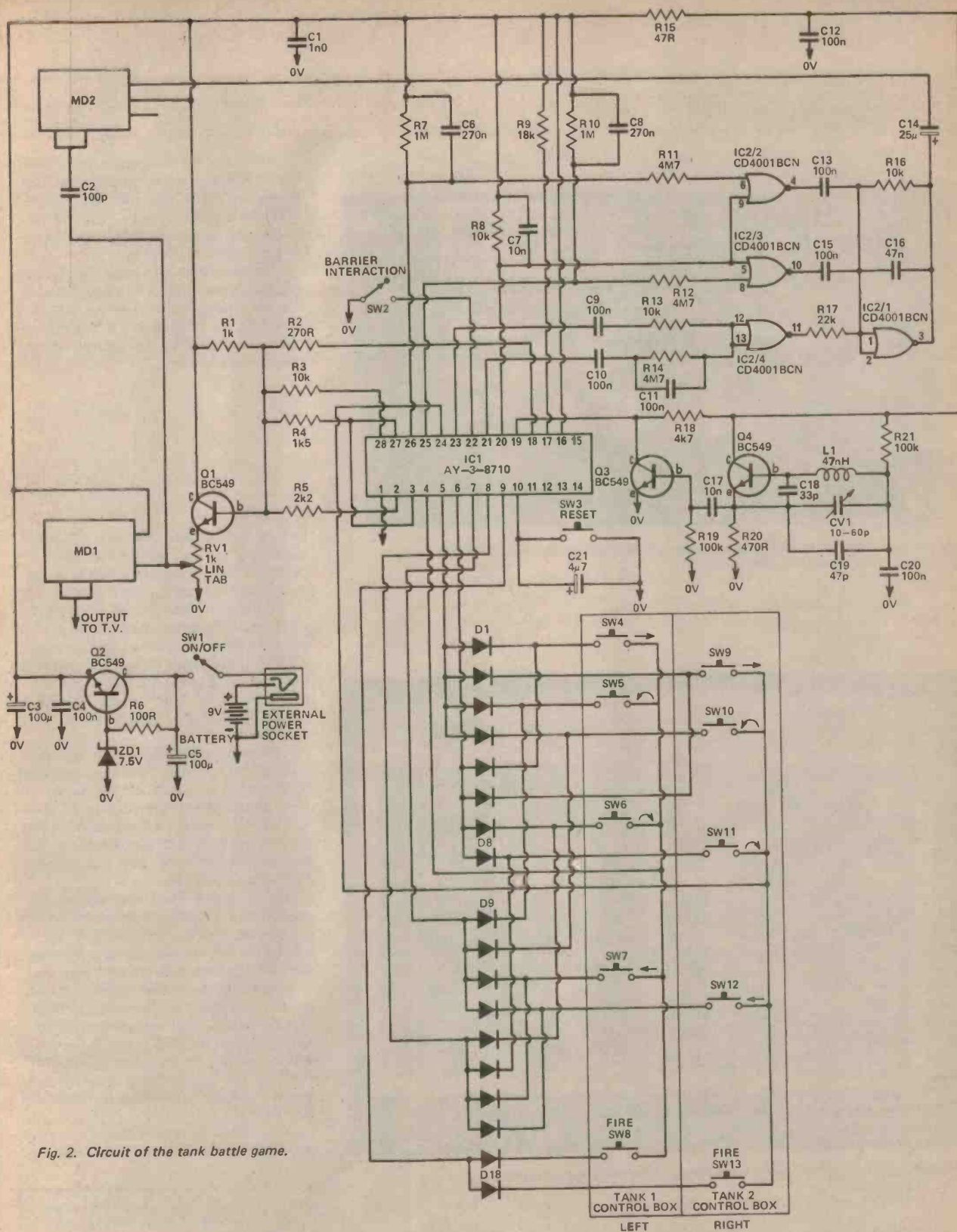
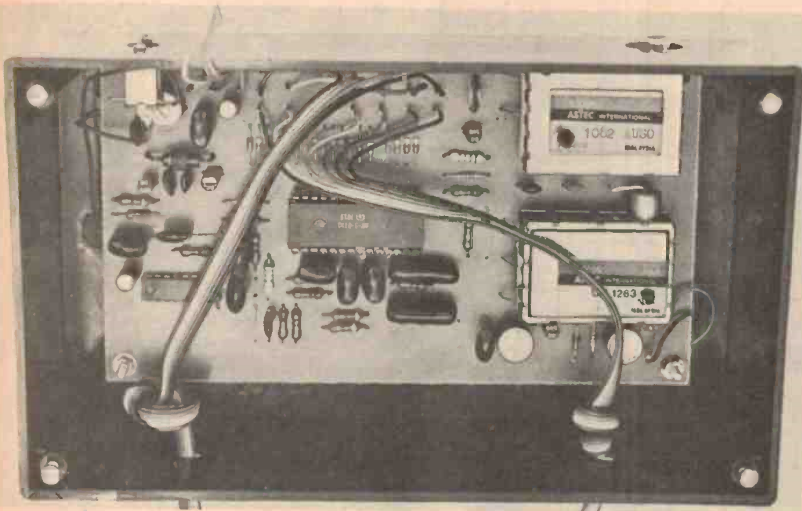
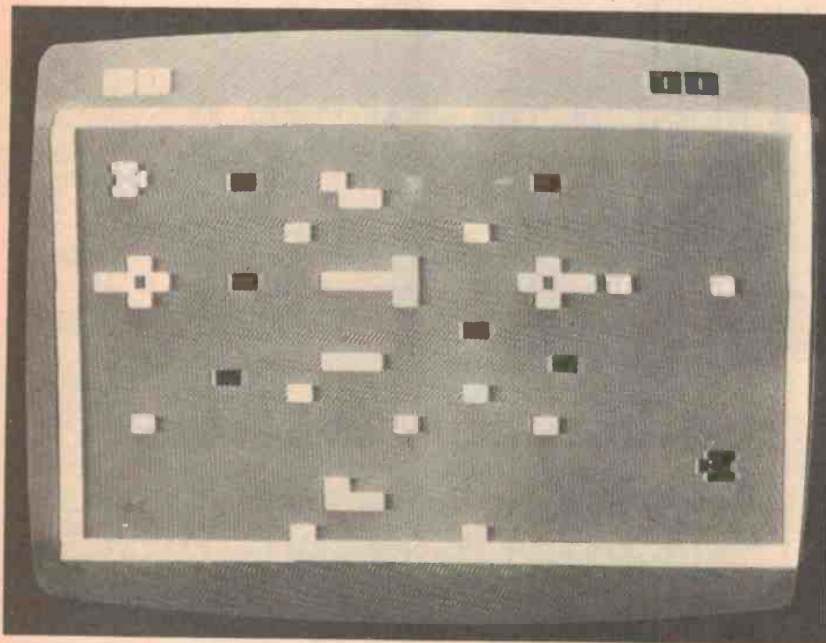


Fig. 2. Circuit of the tank battle game.

Project 811



The completed unit. Note the position of the pcb flush against the rear of the box so the output connector can pass through it.



The battlefield as it should appear on the screen after the setup adjustments.

After the three switches have been assembled on the front panel they can be connected to the unit with about 150 mm lengths of wire. The battery holder can be placed inside the box in any convenient position.

The next step is to assemble the two control boxes and drill a hole in each for the ribbon cable. The switches are wired to the pc board, via the ribbon cable, as shown by the figures on the component overlay.

Setting Up

Before turning the unit on, doubly check that all the components are in the correct positions and that the transistors, diodes and ICs are the right way round.

Connect the unit to the TV set with a length of 75 ohm coaxial cable. If your set does not have a coaxial input a balun transformer may be necessary to match the 75 ohm output from the game to the 300 ohm input of the television. Set the trimpot RV1 to about mid-range.

When the unit is turned on and the television is tuned to the channel number stamped on the top of the video modulator (MD1), the picture on the screen will probably be unsynchronised. By turning CV1 with a screwdriver, the picture should 'lock' and the battle-field should appear.

By adjusting the trimpot RV1 in conjunction with the brightness control on the set, the background grey level can be set for the best picture. Hitting the reset button will initiate the game.

Next, adjust the fine tuning control on the television so the sound effects can be heard. The sound modulator (MD2) has an internal preset adjustment which can be used in conjunction with the fine tuning control to achieve the correct sound. However, this should not be necessary.

This concludes the setting up — your game should now be ready for play.

A complete kit of parts for this project will be available from Dick Smith Electronics.